REPORT

OF

THE DIRECTOR

OF THE

ROYAL OBSERVATORY, HONGKONG,

FOR THE YEAR

1918

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I.—Grounds and Buildings.

The grounds were kept in order by the Botanical and Forestry Department with the assistance of the Observatory coolies.

The Battery room was enlarged in the month of April, and now serves also as a workshop.

Improvements were made to the front verandah of the Director's Quarters in May.

A new magnetic hut was completed in December. The north pillar of the new hut bears N 31° 40′ E from the north pillar of the old hut and N 85° 29′ W from the nearest corner of the main building. It is distant 133 feet from the former and 292 feet from the latter.

The old hut was in a bad state of repair and required renewal. The new site is farther from the Church, the Church Hall, and the site of contemplated quarters in the Observatory grounds.

A portion of the path to the north and east of the main building was reconstructed, with concrete, in December.

A concrete path, running southward from the new magnetic hut to the path leading to the old magnetic hut, was constructed in December.

II.—Meteorological Instruments.

Barometers.—The receipt of two barometers from London in April, a small standard Casella No 2451, and a station barometer M. O. 1409, afforded an opportunity of checking the index error of the Observatory Standard, N. & Z. 1368.

The results of the comparisons are given in the following table, together with the results obtained in former years:—

Index correction of the Standard barometer of the Royal Observatory Hongkong, 1883 to 1918.

Year.	Index Correction.	From Comparisons with
	in.	
1883	− ·007	The Kew Standard.
1893	− ·004	Dolland Standard No. 5642.
1898	− ·007	Casella Station No. 1323.
1909	− ·004	Hicks Standard No. 32.
1911	− ·005	Casella Standard No. 2451.
1918	− ·004	Do. (after repair by makers).
1918	− ·005	M. O. Station No. 1409.

The results are very satisfactory, particularly as the Observatory Standard is not very massive and the diameter of the tube is only 0·5 inch. It would appear that the published values of barometric pressure have always been within ·003 inch of the Kew Standard.

Kew Barograph.—There is considerable difficulty in obtaining good definition of the registers with this instrument. It is expensive to maintain, on account of the photographic paper and the electric light, the bulb for which seldom lasts for more than two weeks. It is proposed to substitute a Marvin compensated barograph.

Beckley Anemograph.—This instrument was oiled once a month, and the orientation of the head checked.

Dines Anemograph.—The head was oiled once a month, and the spindle of the float cleaned and oiled once a week. The orientation of the head was checked monthly.

The monthly results of comparisons with the records of the Beckley Anemograph since the installation of the Dines instrument, in April 1910, are given below: —

Month.	Factor (Dines ÷ $\frac{\text{Beckley}}{3}$).								
	1910.	1911.	1912.	1913.	1914.	1915.	1916.	1917.	1918.
January, ...	...	2·33	2·30	2·12	2·54	2·03	2·08	2·04	1·69
February, ...	...	2·34	2·32	2·30	2·40	2·06	2·23	2·04	1·89
March, ...	...	2·30	2·35	2·25	2·33	2·04	2·26	2·02	1·98
April, ...	...	2·27	2·33	2·26	2·25	2·05	2·33	2·05	1·91
May, ...	2·23	2·25	2·34	2·22	2·13	2·23	2·36	1·97	2·13
June, ...	2·23	2·10	2·44	2·09	2·13	2·22	2·26	1·93	2·57
July, ...	2·14	2·21	2·57	2·28	2·26	2·05	2·80	2·02	2·52
August, ...	2·07	2·25	2·65	2·39	2·18	2·07	2·88	1·93	2·43
September, ...	2·18	2·31	2·49	2·81	2·22	2·19	2·21	2·07	2·21
October, ...	2·30	2·27	2·51	2·69	2·08	2·23	2·10	2·00	1·85
November, ...	2·28	2·27	2·47	2·71	2·08	2·08	2·04	1·67	1·75
December, ...	2·23	2·31	2·24	2·54	2·07	2·07	2·10	1·68	1·75
Year, ...	2·21	2·27	2·42	2·39	2·22	2·11	2·30	1·95	2·06

The Scale value of the instrument was determined in the month of May by means of a gauge constructed at the Observatory. It appeared to be correct within the probable error of observation, which was about 1 mile at a velocity of 80 m.p.h., increasing to 3 miles at 10 m.p.h.

Thermometers.—All thermometers in use were compared with the Kew Standard in winter and summer.

Thermograph.—The Richard dry and wet bulb thermograph, ordered to replace the old Kew photographic thermograph, was received on 1917 March 20, and set up in the thatched shelter the following day. After a few months use the aluminium levers commenced to crumble, and were replaced by thin brass levers on 1917 December 22. The recording cylinder is 5 inches in diameter,

and turns once in 24 hours. The electrical time-break apparatus was completed on 1917 April 22. The pens are lifted from the paper, for the first three minutes of each hour, by a make-contact on one of the electric dials. The thermometers are aspirated from the 59th to the 60th minute of each hour by an electric fan, operated by a similar contact on another dial, air being drawn into the shelter through a 14-inch zinc pipe. Comparison between the eye observations of thermometers rotated in the open air and the records of the Richard thermograph indicate that the relation between the temperature in the shelter and in the open air is not constant.

The effect of the electric fan on the wet bulb thermometer under varying conditions of temperature, humidity, and wind has been discussed. Further particulars are given under the heading Miscellaneous.

Peak Anemograph.—An electric time scaling apparatus was fitted to the Beckley Anemograph at Victoria Peak in the month of May. The spiral pencils are lifted from the paper by an electromagnet, operated by an hourly signal from the Observatory, and held by a trigger which is released 10 minutes after the hour by mechanism fitted to the driving clock.

III.—Meteorological Observations at the Observatory.

Continuous photographic records showing the variations of barometric pressure and temperature of the air and of evaporation were obtained with the Kew barograph and the Richard dry and wet bulb thermograph, also automatic records of the direction and velocity of the wind with a Beckley and a Dines-Baxendell anemograph, modified as described in the Report for 1912. The amount of rain is recorded automatically by a Nakamura pluviograph, the amount of sunshine by a Campbell-Stokes universal sunshine recorder, and the relative humidity of the air by a small Richard hair hygrograph.

Eye observations of barometric pressure, temperature of the air and of evaporation, and the amount of cloud were made at each hour of Hongkong Standard time. The character and direction of motion of the clouds were observed every three hours. Daily readings were taken of self-registering maximum and minimum thermometers.

Principal Features of the Weather.—The principal features of the weather in 1918 were:—

(*a*) The continuance until the end of February of the fine dry weather which commenced at the beginning of November 1917.

(*b*) The heavy rains of June ($24{\cdot}795^{\text{ins.}}$) August ($29{\cdot}230^{\text{ins.}}$) and September ($18{\cdot}450^{\text{ins.}}$).

(*c*) A typhoon which passed about 40 miles to the south-west of Hongkong, on the morning of August 15.

January was a record month as regards most elements. Barometric pressure and sunshine were the greatest on record, and

the temperature, humidity and cloudiness the least on record. The wind direction, NE by E, was with 1890, 1898 and 1899 the most northerly on record, and the wind velocity was only 0·2 m.p.h. greater than the least on record (1916).

Barometric pressure was considerably above normal in January and considerably below in July. Departures from normal in other months were small. The mean pressure for the year at station level was 29ins.·847 as against 29ins.·845 in 1917, and 29ins.·844 for the past 35 years. The highest pressure was 30ins.·391 on January 8 as against 30ins.·494 in 1917 and 30ins.·509 for the past 35 years. The lowest pressure was 29ins.·108 on August 15 as against 29ins.·078 in 1917 and 28ins.·735 for the past 35 years.

The monthly departures of temperature from normal were small, except in January when the mean temperature was no less than 5°·8 below normal. The mean temperature for the year was 71°·2 as against 71°·0 in 1917 and 71°·8 for the past 35 years. The highest temperature was 91°·2 on July 14 as against 90°·8 in 1917 and 97°·0 for the past 35 years. The lowest temperature was 42°·1 on January 9 as against 38°·8 in 1917 and 32°·0 for the past 35 years.

The rainfall was considerably below the average from January to May and considerably above the average in June, August, and September. The total for the year was 101ins.·605, the greatest on record since 1894 when it was 104·25 inches. The greatest fall in one civil day was 7·395 inches on August 3, and the greatest in one hour was 2·420ins. between 1 a.m and 2 a.m on September 21.

Rainfall at Four Stations.—In the following table the monthly rainfall at the Observatory is compared with the fall at the Police Station, Taipo, the Botanical Gardens, and the Matilda Hospital, Mount Kellet :—

Months.	Observatory (*Kowloon*).	Police Station (*Taipo*).	Botanical Gardens (*Hongkong*).	Matilda Hospital (*Hongkong*).
	inches.	*inches.*	*inches.*	*inches.*
January, ...	0·010	.....	0·01	.....
February, ...	0·015	0·22	0·06	0·02
March, ...	1·105	1·29	1·35	1·36
April, ...	4·440	4·65	4·13	4·44
May, ...	6·655	7·66	8·79	5·60
June, ...	24·795	23·64	26·24	24·66
July, ...	11·640	*30·87	12·50	8·32
August, ...	29·230	40·48	30·23	26·35
September,...	18·450	13·17	19·87	17·33
October, ...	0·050	0·85	0·04	0·01
November, ...	5·075	5·74	5·83	6·17
December, ...	0.140	0·58	0·70	0·60
Year,...	101·605	129·15	109·75	94·86

* Heavy local thunderstorms on 23rd and 29th.

Floods.—The heaviest rainfall occurred at the Observatory as follows:—

Period.									Amount.	Duration.
									inches	*hours*
June	9d	5h	to	June	20d	0h	...	...	20·265	96
July	29	16	„	August	5	20	...	...	22·490	85
Sept.	16	6	„	Sept.	22	14	...	...	15·735	71

Typhoons.—The tracks of 18 typhoons and 9 of the principal depressions which occurred in the Far East in 1918 are given in two plates in the Monthly Meteorological Bulletin for December 1918. The centre of a typhoon passed about 40 miles to the south west of the Observatory on the morning of August 15. The maximum hourly wind velocity recorded at the Observatory by the Beckley Anemograph was 63 miles at 6h., and the greatest squall velocity (Dines—Baxendell Anemograph) was at the rate of 94 m.p.h. at 6h. 10m. At Victoria Peak the Beckley Anemograph recorded 75 miles between 10h. and 11h. Very little damage occurred in Hongkong.

IV.—Publications.

Daily Weather Report and Map.— A weather map of the Far East for 6 a.m. of the 120th meridian, and the Daily Weather Report (containing meteorological observations, usually at 6h. and 14h., from about 40 stations in China, Indo-China, Japan, the Philippines, and Borneo), and daily weather forecasts for Hongkong to Gap Rock, the Formosa Channel, the south coast of China between Hongkong and Lammocks, and between Hongkong and Hainan, were issued as in former years. Copies of the map were exhibited on notice boards at the Hongkong Ferry Pier, the Blake Pier, and the Harbour Office. One copy was sent daily to the Director of the Meteorological Observatory, Macao. Forty copies of the Daily Weather Report were distributed to various offices, etc., in the Colony, and a copy was sent daily to the Director of the Meteorological Observatory, Macao. Copies were sent every week to Lieutenant Commander Pradiyat, Royal Siamese Navy.

A charge of $10 a year is made for supplying private firms and individuals with the Daily Weather Report, and $36 for the Weather Map. No map was published on February 3, 21, and 24, March 4, 8, and 17, April 2 and 7, May 5, 12, and 26, June 20, July 2, 3, 5, and 7, and December 25, owing to the late arrival of the weather telegrams. On many other occasions the map, though published, contained but meagre information.

The weather forecast is telegraphed daily to the Cape d'Aguilar Wireless Station in time for distribution at 1 p.m.

From April 10 to 25 special forecasts of the weather between Hongkong and Shanghai were telephoned to the naval authorities twice daily, in connection with the despatch of two monitors to Shanghai.

Monthly Meteorological Bulletin.—The Monthly Meteorological Bulletin, which includes the Daily Weather Report, was published as usual, but distribution to the United Kingdom, Europe, and India was postponed owing to the war.

Miscellaneous Returns.—A monthly abstract of observations made at the Observatory is published in the *Government Gazette*, and daily, monthly, and yearly results are published in the Blue Book in the form suggested by the London Meteorological Office for the British Colonies.

The monthly departures from normal of the barometric pressure at four China Coast Ports were communicated to the Commonwealth Meteorologist, Melbourne, in connection with long range weather forecasts. Monthly meteorological returns are forwarded to Symons's Meteorological Magazine, and annual returns to the Stock Exchange Official Intelligence and the Colonial Office List.

V.—Weather Telegrams, Forecasts, and Storm Warnings.

Daily Weather Telegrams.—Owing to the war, and the disturbed state of China, the service of daily weather telegrams from the various reporting stations was erratic, particularly in the case of Central and Southern China, Indo-China, Japan, and Vladivostock.

Representations to the Eastern Extension Cable Company at Shanghai and Hongkong have improved the service from Shanghai and Manila.

Extra Weather Telegrams.—The following stations send extra weather telegrams at half-rates during typhoons, on receipt of certain code words from Hongkong:—Amoy, Canton, Macao, Phulien, Sharp Peak, and Taihoku. The Director of the Philippines Weather Bureau also sends extra telegrams, at his discretion, from Aparri or some other station nearer the typhoon centre.

The extra 9 p.m. telegram usually received from Swatow during the typhoon season, was frequently lacking, owing probably to the disturbed condition of the country.

Wireless Weather Telegrams.—The development of this service has been impeded by the war. Wireless weather telegrams have been received from Japanese and Dutch ships, however, as follows:—

Month.	*Dutch.*	*Japanese.*
January,	6	2
February,	7	3
March,	5	2
April,	–	1
May,	2	–
June,	2	3
July,	3	2
August,	2	–
September,	4	–
October,	4	–
November,	4	–
December,	2	1
Totals 1918,	41	14
Totals 1917,	93	37
Totals 1916,	95	60

It is hoped that it may be possible to organise a satisfactory service of wireless weather telegrams in the near future.

Results of Weather Forecasts.—The results of the comparison of the daily weather forecasts with the weather subsequently experienced are given below, with the results of the previous five years:—

Year.	Complete Success.	Partial Success.	Partial Failure.	Total Failure.
	%	%	%	%
1913	66	28	3	3
1914	62	32	5	1
1915	54	37	8	1
1916	67	29	3	1
1917	67	29	4	0
1918	71	26	3	0

The forecast comprises wind direction, wind force, and weather.

Complete success means correct in three elements.

Partial success means correct in only two elements.

Partial failure means correct in only one element.

Total failure means correct in no element.

Commencing with 1918, January 1, a new method of analysis has been adopted in the case of the elements "wind force" and "weather".

The old and new methods are compared below :—

Old method. 1896-1917	*New method.* 1918
(1) Wind Direction :—	(1) Wind Direction :—
The forecast wind direction is considered successful if the wind at Gap Rock blows the greater part of the 24 hours from a direction that does not differ more than 45° from the forecast. Thus, if the forecast wind direction is NE, and 4 out of the 6 reports from Gap Rock give wind direction between N and E the forecast is correct in this element.	The same as in old method.
(2) Wind Force :—	(2) Wind Force :—
The wind force forecast "Light" is successful if the mean force registered at Gap Rock is a light breeze, or if the wind force does not reach the force of a moderate breeze. "Moderate" if the mean is a moderate breeze, or if the wind force exceeds a light breeze and falls short of a strong breeze. "Fresh" if the mean is a fresh breeze, or if the wind force exceeds a gentle breeze and falls short of a moderate gale. "Strong" if the mean is a strong breeze, or if the wind force exceeds a moderate breeze and falls short of a fresh gale. "Gale" if it blows more than 40 miles per hour at Gap Rock.	The wind force forecast is successful if in $\frac{5}{6}$ of the observations at Gap Rock, Waglan, or Hongkong the force is within the ranges given in the following table :—
	Forecast. — *Range.* (Beaufort Scale)
	Light 0–3
	Moderate 2–5
	Fresh 4–6
	Strong 5–7
	"Gale" is correct if the wind attains force 8 at Gap Rock, Waglan, or Hongkong.
(3) Weather :—	(3) Weather.
The weather forecast "Fine" is successful when the mean amount of cloud is below 7 (10=an overcast sky), if sunshine or starlight	The weather forecast is successful if the amount of cloud and rainfall is in accordance with the following table :—

prevails, and when it does not rain for more than one hour out of the twenty-four. "Fair," "Cloudy," if the amount of clouds exceeds 3 and it does not rain for more than one hour. "Showery" if it rains at intervals and is fair at intervals. "Wet, rainy" if it rains for more than 4 hours.

Forecast.	*Mean Amount of Cloud*	*Rainfall*
"Fine"	less than 7	less than 1 hour
"Fair"	greater than 3 and less than 10	do.
"Cloudy"	7 or more	do.
"Overcast"	10 for 18 hours or more	do.
"Rainy or Rain"	——	4 hours or more

Weather forecasts involving other terms, or any combination of the above, are judged upon the general character of the cloud and weather notes in the Royal Observatory journal, and the reports from stations in the district.

Storm Warnings.—Storm warnings according to the Hongkong Local and Non-Local Codes are displayed at the Signal Hill, Kowloon. The following ports are warned by the non-local code:—Sharp Peak, Swatow, Amoy, Santuao, Macao, Canton, Wuchow, Pakhoi, Hoihow, Phulien, Taihoku, Manila, Labuan, and Singapore.

The local day signals are repeated at the Harbour Office, H.M.S. *Tamar*, Green Island, the Godown Company Kowloon, Lyemun, and Lai-chi-kok.

The local night signals are exhibited on the tower of the Kowloon Railway Station and repeated on H.M.S. *Tamar* and over the Harbour Office.

For the benefit of native craft and passing ocean vessels, a cone is exhibited at several outlying stations during the time that any of the local signals are displayed in the Harbour, to indicate that there is a depression somewhere in the China Sea, and that a typhoon warning is displayed in the Harbour.

In the following table are given the number of hours the local signals were hoisted in each of the years 1912-1918 :—

Year	Red Signals.	Black Signals.	Bombs.*
	Number of hours hoisted.		Number of times fired.
1912	151	164	...
1913	146	189	1
1914	146	178	...
1915	64	120	...
1916	70	201	1
1917	102	36	...
1918	33	102	1

The figures in the above table include the number of hours that night signals, corresponding to the day signals, were hoisted.

Prior to July, 1917, the red signals indicated that the centre of the typhoon was believed to be more than 300 miles distant, and the black less than 300 miles, the returns for 1912-1916 are therefore not strictly comparable with those for 1917 and 1918. The latter suggest however that the use of the new local storm warning code has already saved the Colony a considerable amount of money. The loss incurred by the disorganisation of the work in the harbour, consequent upon the display of typhoon signals, is not easy to estimate. It probably amounts to many thousands of dollars a day, however.

VI.—Meteorological Observations from Ships, Treaty Ports, &c.

Logs received.—In addition to meteorological registers kept at about 40 stations in China, meteorological logs were received from 34 ships operating in the Far East. These logs, representing 2,223 days' observations, have been utilised for verifying typhoon tracks. The corresponding figures for the year 1917 were 85 and 3,767.

Pilot Charts.—No progress has been made with the construction of Pilot Charts owing to the absence of the First Assistant on military service.

* Three bombs fired at intervals of 10 seconds indicate that wind of typhoon force is anticipated.

Comparison of Barometers.—During the year about 350 comparisons of ships' barometer have been made by means of observations taken when in harbour, and several direct comparisons of barometers for shipmasters and various persons in the Colony have been made at the Observatory.

VII.—Magnetic Observations.

Absolute determinations of magnetic horizontal force and declination were made in the old magnetic hut, near the middle of each month, with a Kew pattern magnetometer, Elliott No. 55, and of dip with a Kew pattern dip circle, Dover No. 71; four dip needles being used in rotation. A complete determination of horizontal force consists of one set of vibrations taken between two sets of deflections.

The mean values of the Magnetic elements for the years 1917 and 1918 were as follows:—

	1917	*1918*
Declination (west)	0 16 16	0 17 57
Dip (north)	30 50 22	30 48 19
Horizontal Force (C. G. S. unit)	0·37163	0·37164
Vertical Force (C. G. S. unit)	0·22188	0·22159
Total Force (C. G. S. unit) ...	0·43282	0·43269

VIII.—Time Service.

Time Ball.—The Time Ball on the Signal Hill, Kowloon, is dropped daily at 13h., Hongkong Standard Time (5 a.m of Greenwich Time). The ball in also dropped at any other hour in case of necessity. No applications for a supplementary signal were made in 1918.

The ball was dropped successfully 353 times. There were 11 failures:—On January 14th it failed from no ascertainable cause, on March 19th, July 3rd and 4th owing to electrical defects, and on October 6 and 7 owing to trouble with the lock. On October 8 the lock was removed for repair and the spare lock substituted. This lock is known to be unsatisfactory, and it failed to drop the ball on December 4, 12, 16, 23 and 24. On December 25 the normal lock was again brought into use. The ball was dropped at 14h. on January 14th, 15h. on July 3, October 7, December 12, and December 16, and at 16h. on December 24. The ball was not raised on August 15th, on account of high wind.

The ball fell with an error of 0ˢ·3 or less on 324 occasions, and with an error of 0ˢ·4 or 0ˢ·5 on 23 occasions. Errors of 0ˢ·6 and 0ˢ·8 occurred once, and of 0ˢ·7 and 0ˢ·9 twice.

The probable error of the Time Ball was $+0^{s}\cdot14$; the monthly values for the past 5 years are given below :—

Month.	Probable Error of Time Ball.				
	1914	1915	1916	1917	1918
January,	±0·18	±0·17	±0·15	±0·17	±0·11
February,	·15	·44	·28	·10	·13
March,	·21	·17	·17	·11	·15
April,	·22	·38	·18	·18	·10
May,	·25	·16	·10	·17	·12
June,	·16	·15	·17	·10	·14
July,	·20	·17	·10	·21	·11
August,	·21	·15	·10	·11	·26
September,	·14	·13	·11	·10	·16
October,	·14	·10	·13	·10	·12
November,	·13	·16	·13	·10	·12
December,	·28	·14	·11	·10	·14
Means,	±0·19	±0·19	±0·14	±0·13	±0·14

Transit Instrument.—Observations for time were made daily with the 3 inch transit and the Hipp tape chronograph by the Chinese computers, weather permitting.

The number of observations in the years 1917 and 1918 were as follows :—

	1917.	*1918.*
Transits, ...	1,924	1,522
Level determination, ...	952	787
Azimuth ,, ...	44	23
Collimation ,, ...	40	22

No transits of the sun were utilized during 1918.

The azimuth and collimation determinations were made by the Director and Chief Assistant. The azimuth determinations depend usually upon observations of the old south mark.

Clocks.—Early in January the clocks were removed from their piers and the piers demolished, in order to relieve the congestion in the clock room and to facilitate entrance to the extended battery room. The Standard Sidereal and the Brock Mean Time clocks were placed on the west wall 9 feet apart, and the Dent Mean Time clock on the north wall, 3 feet from the NW corner of the room.

The losing rate of the Sidereal Standard clock Dent No. 39741 varied from $0^{s}\cdot00$ on February 14th (Bar. $30^{ins.}\cdot13$, Temp. $61^{\circ}\cdot6$) to $-0^{s}\cdot57$ on August 15 (Bar. $29^{ins.}\cdot35$, Temp. $81^{\circ}\cdot2$) and October 5 (Bar. $29^{ins.}\cdot72$, Temp. $79^{\circ}\cdot1$). The clock was stopped by an earthquake on February 13 and tripped 18 seconds between

November 5 and 6. The rate during cloudy periods was usually derived from the formula:—

$$r = -0^{s}\cdot792 + 0^{s}\cdot575\ (b - 20^{mm}) + 0^{s}\cdot00921\ (t - 50^{\circ})$$

where r is the computed losing rate, and b and t the mean barometric pressure and temperature respectively, for the preceding 24 hours.

In the following table is given the excess of the observed over the inferred rate after cloudy periods during the year 1918:—

Date 1918.		Interval without observations.	Excess of observed over inferred error.
			secs.
March	29	8 days	+0·43
April	13	7 ,,	−0·07
May	4	3 ,,	+0·11
,,	17	5 ,,	+0·76
June	16	3 ,,	−0·25
July	7	1 ,,	−0·23
,,	17	1 ,,	−0·12
August	12	13 ,,	−0·92
,,	17	3 ,,	+0·06
,,	28	5 ,,	−0·05
September	23	5 ,,	−0·39
October	21	2 ,,	−0·05
November	15	5 ,,	−0·33
,,	20	5 ,,	−0·02
,,	26	5 ,,	+0·13
December	16	5 ,,	−0·45

The Brock Mean Time clock was generally in use for dropping the time-ball and driving the dials in various parts of the building until April 12th. From this date until the end of the year Dent No. 39749 was utilized for this purpose. When so employed the clock is corrected daily by the electric regulating apparatus and its daily rate is usually kept below 0·5 by the addition or removal of weights. Chronometer Dent No. 40917 is on loan at the Cape d'Aguilar Wireless Station, and Chronometer Dent No. 39946 at the Peak Signal Station.

Batteries.—The necessary current for the time service, etc., has been satisfactorily supplied by the accumulator battery, charged as found necessary from the alternating mains of the China Light and Power Co. through one of two Nodon valves. A new charging switchboard, designed by Mr. Jeffries, was constructed by the Public Works Department and placed in the clock room on the west side of the time-service switchboard. Much wiring has been saved by this arrangement and the assistant in the clock room can now conveniently superintend all charging operations, adjustments, etc.

In December, 3 Delco accumulator cells of 10 ampère hours capacity, and two test tube 50-volt batteries of very limited

capacity, constructed by Mr. Jeffries, were brought into use in connection with the Wireless Receiving Apparatus.

IX.—Miscellaneous.

Earthquakes.—During the year 1918 several earthquake shocks were felt in Hongkong, the most severe occurring on February 13 as follows:—

A series of shocks commenced at 14h. 7m. on February 13, and continued at intervals until 16h. 50m. on the 14th. The first shock was the most severe and would be classed as No. 6 in the Rossi-Forel scale of 1 to 10 (Fairly strong shock, sleepers awakened: persons sufficiently startled to leave their houses, clocks stopped, oscillation of chandeliers). It commenced with a very feeble vibration at 14h. 7m. and increased until 14h. 9m. when the shaking of buildings was alarming. It died away at 14h. 12m. This was apparently the most severe earthquake ever felt in Hongkong.

At the Observatory, Kowloon, two clocks with seconds pendulums swinging in the meridian stopped; the Brock mean time clock at 14h. 9m. 9s., and the Dent Sidereal clock, at 14h. 9m. 38s. The Dent mean time clock whose pendulum swings in an E-W direction was not perceptibly affected. The barograph clock, which also swings in an E-W direction stopped at 14h. 10m.; the barograph trace was not perceptibly affected however. In the upstair rooms several cracks appeared in the walls, glasses were overturned and the support of a cabinet shelf was shaken down. A $\frac{3}{4}$ seconds pendulum clock, swinging in an E-W direction was not stopped, but its rate, which had been practically zero for about 10 days, was affected to an extraordinary degree. By 17h. the clock had gained 2 minutes, and by 21h. it had gained 5 minutes. Its arc of vibration was reduced considerably. No explanation of these derangements was found.

One striking effect on the stopped clocks was the rapidity with which the pendulums came to rest. The bobs weigh about 15 pounds, and if allowed to swing freely will remain in motion for 2 hours or more; whereas they both came to rest a few minutes after the first vibrations were felt.

A small, short pendulum mantel clock at the Club House, Fanling, swinging in a N-S direction, stopped at 14h. 9m., while the seconds pendulum clock, which faces a little to the west of north was not perceptibly affected.

A seconds pendulum clock swinging in a NW-SE direction in Messrs. Falconer and Co.'s shop, Hongkong, stopped at 14h. 10m. but a similar clock, about 2 yards distant, swinging in a NE-SW direction was not perceptibly affected.

Of the two pendulum clocks used by the Telephone Company for driving their Standard Time Clocks, only one was stopped (14h. 9m.). They both face west. Several of the Asiatic Petroleum Company's pendulum clocks stopped, but none of those which were facing north.

Several buildings in Hongkong were slightly damaged.

In addition to the principal shock at 14h. 9m. other movements were felt as follows:

Time.		*Character.*	*Approximate duration in seconds.*
h.	*m.*		
13d. 14	48	slight rumble	momentary.
15	9	slight shock.	momentary.
16	11	slight shock.	momentary.
21	27	slight shock.	5
22	36	moderate	5
22	55	feeble.	momentary.
23	10	feeble.	momentary.
14d. 1	12	moderate; doors shaken	6
1	39	very slight, increasing to moderate; doors shaken.	7
2	54	very slight, rumble.	momentary.
4	26	very slight, increasing to very pronounced shock. shaking of doors somewhat alarming.	20
5	20	slight shock.	3
16	50	slight to moderate shock.	3

The increased movement at 14d. 1h. 12m. suggested that the previous shocks were possibly precursors of a local earthquake. Telegrams were therefore sent to the Observatories at Manila, Taihoku, and Zikawei, asking them to give the origin of the disturbance, with a view to issuing local warnings if necessary. Replies from all three Observatories were received by 14d. 16h. The mean of the three estimations given by the above Observatories is latitude 26° N. and longitude 115° E. or about 250 miles N. by E. of Hongkong. The distances given by Shanghai and Taihoku, however, make the origin at Swatow.

It appears that the origin was a few miles to the north-west of Swatow.

Other shocks felt during the year were as follows:—

Time				*Character*	*Approximate duration in seconds.*
	d.	*h.*	*m.*		
March	6	5	22	slight tremors.	3
May	8	21	39	decided shock.	4
..	25	0	3	decided shock.	5
June	26	3	29	slight shock.	3
July	20	20	16	rather sharp shock.	3
Aug.	23	1	36	slight shock.	3
Nov.	18	11	29	.. ..	5
Nov.	21	3	25	.. ..	6

Hygrometric Tables.—The question of improved hygrometric tables and methods has been considered in correspondence with the British Meteorological Office, but owing to the war no definite scheme of improvement has been decided upon. 3,375 observations of the effect of an electric fan on the wet bulb thermometer in the "Indian" shelter at this Observatory have been discussed. It appears that the quantities given in the following table should be subtracted from the readings of the wet bulb thermometer in this form of shelter, at varying wind velocities and for varying depressions of the wet bulb :—

Corrections to be applied to the readings of an unaspirated wet bulb thermometer in an "Indian" shelter to reduce them to those of an aspirated thermometer, at different wind velocities and for different depressions of the wet bulb.

Wind velocity.	t − t (Fah).									
	1	2	3	4°	5	6°	7	8	9	10
m. p. h.										
0	·1	·3	·4	·5	·6	·8	·9	1·0	1·2	1·3
1	·1	·2	·3	·4	·5	·7	·8	·9	1·1	1·2
2	·1	·2	·3	·4	·5	·6	·7	·9	1·0	1·1
3	·1	·2	·3	·4	·4	·6	·7	·8	·9	1·0
4	·1	·1	·2	·3	·4	·5	·6	·7	·8	·9
5	·1	·1	·2	·3	·4	·5	·5	·6	·7	·8
6	·0	·1	·2	·2	·3	·4	·5	·6	·7	·7
7	...	·1	·1	·2	·3	·4	·4	·5	·6	·6
8	...	·1	·1	·2	·3	·3	·4	·4	·5	·6
9	...	·1	·1	·2	·2	·3	·3	·4	·4	·5
10	...	·1	·1	·1	·2	·2	·3	·3	·4	·4
11	...	·0	·1	·1	·2	·2	·2	·3	·3	·3
12	...	...	·1	·1	·1	·2	·2	·2	·2	·3
13	...	...	·1	·1	·1	·1	·2	·2	·2	·2
14	...	...	·1	·1	·1	·1	·1	·1	·2	·2
15	...	...	·1	·1	·1	·1	·1	·1	·1	·1
16	...	...	·1	·1	·1	·1	·1	·1	·1	·1
17	...	...	·1	·1	·1	·1	·1	·1	·1	·1
18	...	...	·0	·1	·1	·1	·1	·1	·1	·1
19	...	...	...	·0	·1	·1	·1	·1	·1	·1
20	...	...	...	...	·0	·0	·1	·1	·1	·1
21	...	...	...	...	...	...	·0	·0	·1	·1
22	...	...	...	...	...	...	...	...	·0	·0

The wind velocity in the above table is that recorded by the Beckley Anemograph, the cups of which are 45 feet above the ground. Mean results suggest that the correction may be about a tenth of a degree less with east winds than with winds from other quarters, though the observations are discordant and this cannot be definitely accepted at present. In any case the amount is almost negligible and indicates that the exposure is satisfactory.

Certain of the observations indicate that the correction is smaller at low than at high wet bulb temperatures, but this also requires further investigation.

It would appear that the first step towards the improvement of hygrometric methods is to derive corrections similar to the above for various types of screens, for use where aspirated thermometers are not available, and to construct new hygrometric tables based upon the best observations with rotating thermometers and some approved hygrometer. The question of units should also be considered.

Commencement of the Astronomical Day.—The following is my reply to a letter addressed to "The Observatory" by the Astronomer Royal and the Savilian Professor of Astronomy at Oxford, asking for expressions of opinion on the subject of a proposed alteration in the commencement of the Astronomical Day:

The Astronomer Royal,
Royal Observatory,
England.

Sir,

With reference to your letter of 1917, July 19, to the Editors of "The Observatory" on the subject of the commencement of the Astronomical Day, I should like to suggest that opportunity be taken of the proposed reform to adopt Universal Time; using the present 180th meridian as the new zero.

The meridian of Greenwich cuts the busiest trade route of the world twice; namely, in the English Channel and the Mediterranean Sea, and also cuts the Cape route, so would be an unsatisfactory zero from the sailor's point of view, whereas the present 180th meridian cuts but a few trade routes and is already used as the meridian at which the date is altered. Incidentally, the commencement of the day by the new Universal Time would correspond to the commencement of the present Astronomical Day.

There may be objections to the scheme, but I think they can hardly outweigh the advantages to be gained by abolishing Local Time, which was a necessity to the ancients but which appears to have no *raison d'être* in the 20th Century. The introduction of zone time was a half measure, pandering to the peculiar though apparently universal idea that the day's routine must be carried out at approximately the same clock time all over the world.

On the introduction of Universal Time each state, or even town, could arrange to regulate its routine by the most suitable hours of Absolute Time. As regards Daylight Saving, places in low latitudes would make the middle of the Working Day coincide with the meridian passage of the mean sun, and in high latitudes would alter office hours etc. according to season, in the same way as the present lighting up times are altered.

Time Signals by Wireless Telegraphy.—The antennæ and earth wires for a wireless receiving set were completed early in the year. It soon became evident however that with the crystal supplied with the receiving set satisfactory signals would not be obtained from Shanghai or Manila. Two audion valves were therefore obtained in June through the courtesy of the wireless officer of the Pacific Mail S.S. *Colombia*. With these valves Mr. Henké, the wireless officer of H.M.S. *Tamar*, kindly lent by the naval authorities to superintend the installation, reported that he had obtained satisfactory time-signals from Manila; but not from Shanghai, owing to its low power and the intervening hills.

As the signals heard by the Director were not sufficiently reliable for clock comparisons, Mr. Henké continued to make experiments with different apparatus and circuits, in order to obtain the best possible result. He is not yet satisfied owing to the want of a reliable potentiometer for the high tension battery and rheostat for the low tension battery. It is hoped that these will soon be obtained.

It is disconcerting to learn that signals from Shanghai cannot be obtained until the sending power of that station is increased. It is also disconcerting to find that § 3 of article 45 of the Service Regulations of the International Radiotelegraph Convention is disregarded. On any night wireless signals may be heard between 8.50 and 9.0 p.m., and 9.50 and 10.0 p.m.; whereas by the above regulation all radiotelegraph stations which, by sending signals, might disturb the reception of wireless time signals, should remain silent at these times.

A service of wireless time-signals from the Royal Observatory, Hongkong, was commenced on September 1, in accordance with the programme given in the following circular.

Radiotelegraphic Time Signals.

Radiotelegraphic land and ship-stations within range of Cape d'Aguilar, Hongkong, are hereby notified that, beginning with 1st September, 1918, Time Signals from the Royal Observatory, Hongkong, will be transmitted by the Cape d'Aguilar Radio Station between 11.56 a.m. and noon, and between 8.56 p.m. and 9.0 p.m. (120th meridian Time) at the even seconds. The 2nd, 28th, 50th, 52nd, and 54th second of each of the above minutes will be omitted, for the purpose of identifying the signals.

The Time Signals will be preceded by the following warning-signals from Cape d'Aguilar between 11.54 and 11.55 a.m. and between 8.54 and 8.55 p.m.:—

CQ DE VPS HK TIME WAIT

Both Warning- and Time Signals will be sent out on a wave length of 1,000 metres from a 5 kw. spark set. The Time Signals will be dots of about 0·2 second duration.

Radiotelegraphic land- and ship-stations within range of Cape d'Aguilar are required to keep silent between 11.54 a.m. and noon, and 8.54 p.m. and 9.0 p.m. (120th meridian Time) in accordance

with Article 45(3) of the Service Regulations appended to the International Radiotelegraph Convention of 1912. Operators are also required to keep themselves provided with the most accurate time available, in order to know when to shut down.

The signals are sent by a programme wheel on the seconds arbor of the Dent Mean Time clock, which operates a relay in parallel with the chronograph. They are transmitted to the Cape d'Aguilar wireless station through the relay, and are emitted as wireless signals by means of a magnetic key. The officer in charge of the wireless station at Sandakan (1,000 miles to the south of Hongkong) reports that he receives them at 9 p.m. as good, medium strength signals.

The service was interrupted on eleven occasions owing to defects on the line between the Observatory and Cape d'Aguilar.

Anti-glare glasses.—In the month of September, thirteen samples of anti-glare glasses were received from the Scientific and Industrial Research Department, London, with a request that they might be tried and reported upon; the object being to provide the Services with the most suitable anti-glare glasses for protection of the eye from the physiological effects of glare and for improving vision in connection with the picking up of air craft. The glasses, with report thereon, were returned on October 21.

Staff.—No change occurred in the European staff during the year. Mr. B. D. Evans, First Assistant, was absent on Military Service throughout the year. He left the Colony on 1917 February 10 and was posted to the 3rd Field Survey Company, Royal Engineers, on April 25.

The Director acted as Cable Censor from July 14 to August 18 and from October 10 to December 3, and as Deputy Cable Censor for the remainder of the year.

Yuen Lai-sang was promoted from 6th grade telegraphist to 5th grade computer on October 1.

Expenditure.—The annual expenditure on the Observatory for the past ten years is as follows:—

Year.	Total Expenditure.	Increase.	Decrease.
	$ c.	$ c.	$ c.
1909	22,388.63	1,278.02	.....
1910	21,787.55	.....	601.08
1911	23,353.02	1,565.47	.....
1912	22,595.08	.....	757.94
1913	24,255.49	1,660.41	.....
1914	25,398.31	1,142.82	.....
1915	23,233.12	.....	2,165.19
1916	21,977.78	.....	1,255.34
1917	26,890.50	4,912.72	.....
1918	20,028.24	.....	6,862.26

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T. F. Claxton,
Director.

1919, February 25.


NORONHA & COMPANY
HONGKONG